

Forced Entry Operations Against Composite Cement Board Walls

Donna C. Day, Dr. Philip G. Malone and
Charles R. Malone

Geotechnical and Structures Laboratory
U.S. Army Engineer
Research and Development Center
Vicksburg, MS



US Army Corps
of Engineers

Topics to Discuss

Background on Cement-Board Construction

Objectives of Study

Goals of Project

Design of Walls

Design of Tests

Results

Conclusions

Recommendations



US Army Corps
of Engineers

Background on Cement-Board Construction



- Cement board construction over steel studs is becoming common because it offers:
 - Reduced insurance rates (qualifies as concrete construction)
 - Reduced risk of fire
 - Reduced maintenance
 - Reduced damage from pests
- No data are available on physical security of walls constructed with cement board



Goals of the Project

- Provide data on cement board walls that can be used in programs for modeling break-in operations
- Find a basic cement-board wall design that will improve security at a reasonable cost



Objectives

- **Develop data on the time required to break through cement-board walls of conventional construction using tools consistent with a low-level threat**
- **Develop data on the time required to break through cement-board walls when the construction is modified so that interior concrete pillars are added to the wall**



Assessing Break-in Resistance



- Test wall sections were prepared from 1/2-in. thick sections of cement board fastened to steel studs
- Manufacturers' recommendations for installation were followed
- Insulation was installed between studs
- Two sheets of cement board were used



Wall Designs

- **Four different types of walls were evaluated**
 - **conventional construction with glass-fiber reinforced cement board**
 - **conventional construction with wood-fiber reinforced cement board**
 - **specialized construction with foamed concrete between widely spaced internal concrete pillars with wood-fiber reinforced cement board on the exterior**
 - **specialized construction with foamed concrete between closely spaced internal concrete pillars with wood-fiber reinforced cement board on the exterior**



Design of Tests

- **Two different kinds of cement board used**
 - **Glass-fiber mesh reinforced**
 - **Wood-fiber reinforced**
- **Two different tool sets used**
 - **Fire axe and pry-bar**
 - **Electric saws and drill**



Design of Tests (2)

- **Test replicated with different attack teams**
- **Attacker assisted by a tool-handler**
- **All of the contact with the wall from the attacker**
- **Penetration was complete when 8 in by 12 in opening was produced**
- **Time to accomplish penetration of each layer with each tool set was tabulated separately**



Attack Tool Set

Axe and Pry Bar

- **Double-bladed fire-fighting axe**
 - 36 in length over all
 - 5.5 lb weight
- **Pry bar**
 - 12 in length
 - 1 lb weight



Attack Tool Set

Electric Saws and Drill



- **Attacker equipped with following tools**

- **Circular saw, 600w rated, carbide blade**
- **Drill, 550w rated, hardened steel auger bit**
- **Reciprocating saw, 600w rated, 6 in long, metal-cutting blade**



Glass Fiber-reinforced Cement Board Wall

- 1/2 in thick, commercial cement board
 - reinforced with plastic-coated fiberglass mesh on front and back surfaces
 - mounted on 20 gauge, galvanized steel studs on 16 in centers
 - attachment done with #8 screw fasteners
- Batts of Fiberglas insulation between studs



Wood Fiber-reinforced Cement Board Wall



- 1/2 in thick, commercial cement board
 - reinforced with wood fiber thorough entire thickness
 - mounted on 20 gauge, galvanized steel studs on 16 in centers
 - attachment done with #8 screw fasteners
- Batts of Fiberglas insulation between studs



Testing Protocols

- Tests done with replication mixing up the attack teams for each replicate
- Time expended in each operation tabulated
- Operation of tools required first panel to be removed, than the insulation, and then the second panel



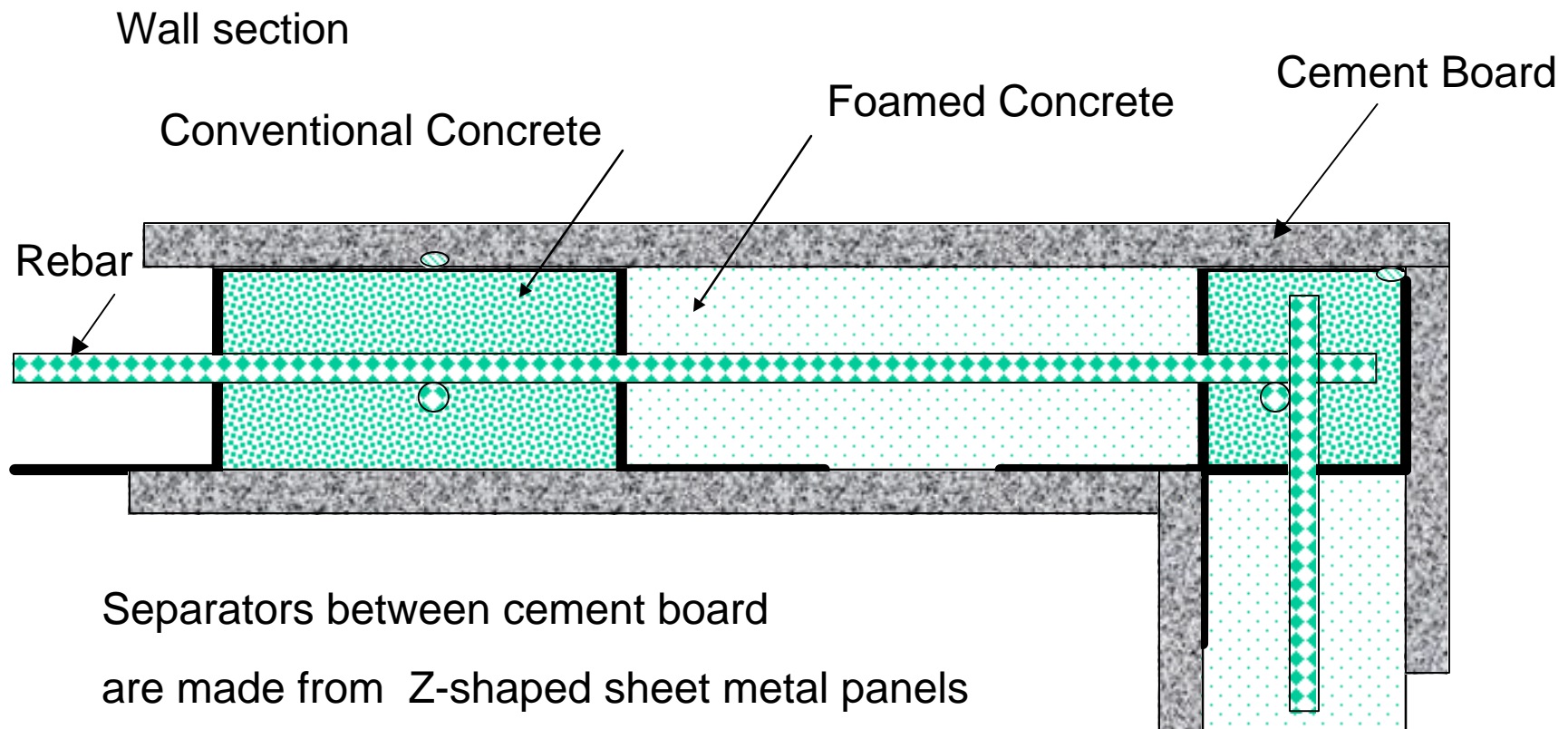
Testing Protocols



- Separate attacks were made on areas between the steel studs and areas that included steel studs
- Penetration was achieved when an 8 in x 12 in x 12 in box could be passed through the wall.



Wall Design with Internal Reinforced Concrete Pillars



Cement Board-Foamed Concrete Wall Section

- Internal pillars were spaced with the edges 8 in apart
- Attack did not involve the internal pillars
- Spaces between pillar were filled with 30 lb/ft³ foamed concrete insulation
- Section contained horizontal rebar embedded in the wall and spaced at 3 ft intervals
- Attack did not involve the rebar



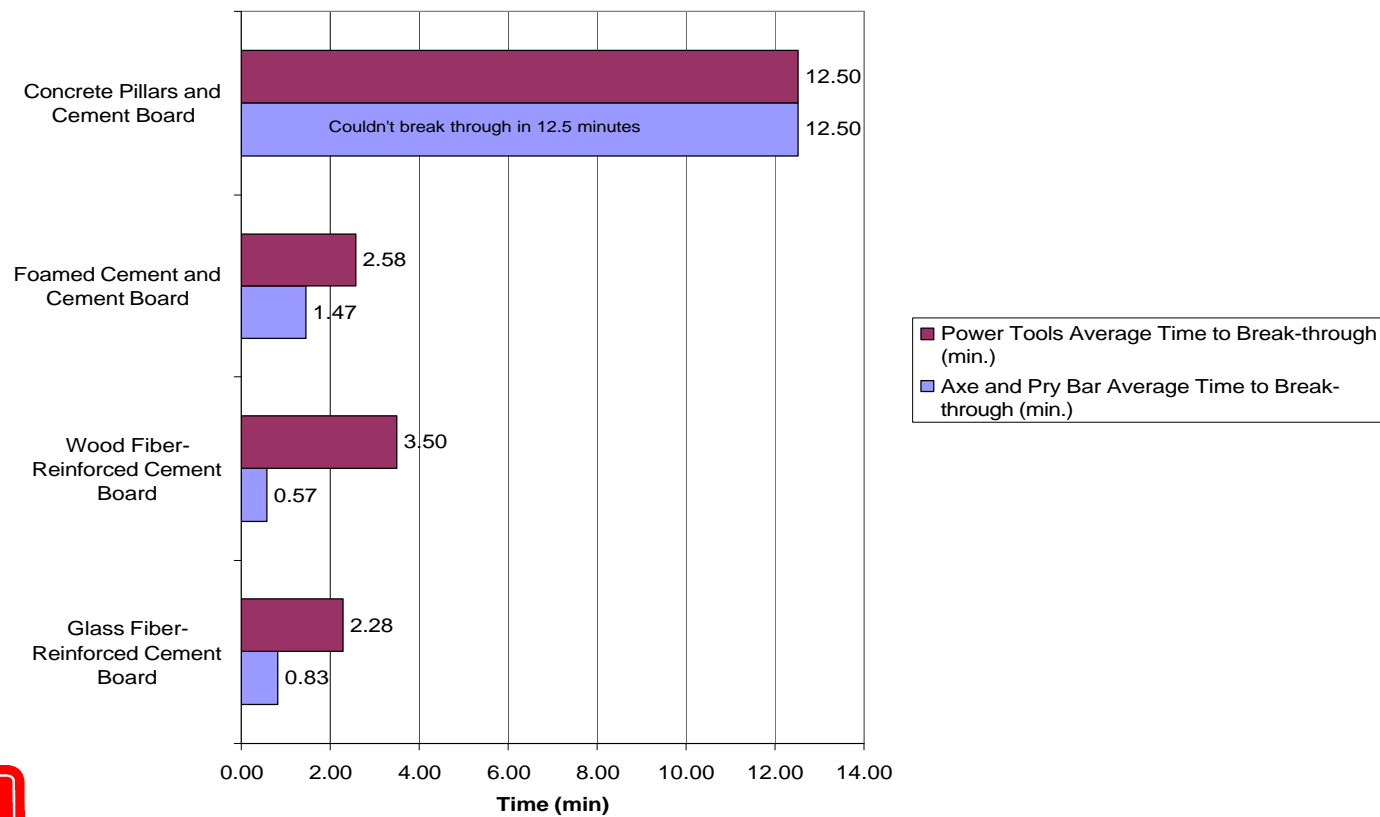
Cement Board-Foamed Concrete Wall With Internal Concrete Pillars

- Pillars are spaced with the edges 8 in apart
- The pillars must be removed or cut to produce the required opening
- The sheet metal spacer covers the concrete pillar
- The pillar contains No. 8 rebar.
- Rebar is positioned horizontally to hold the pillars together as a unit



Results

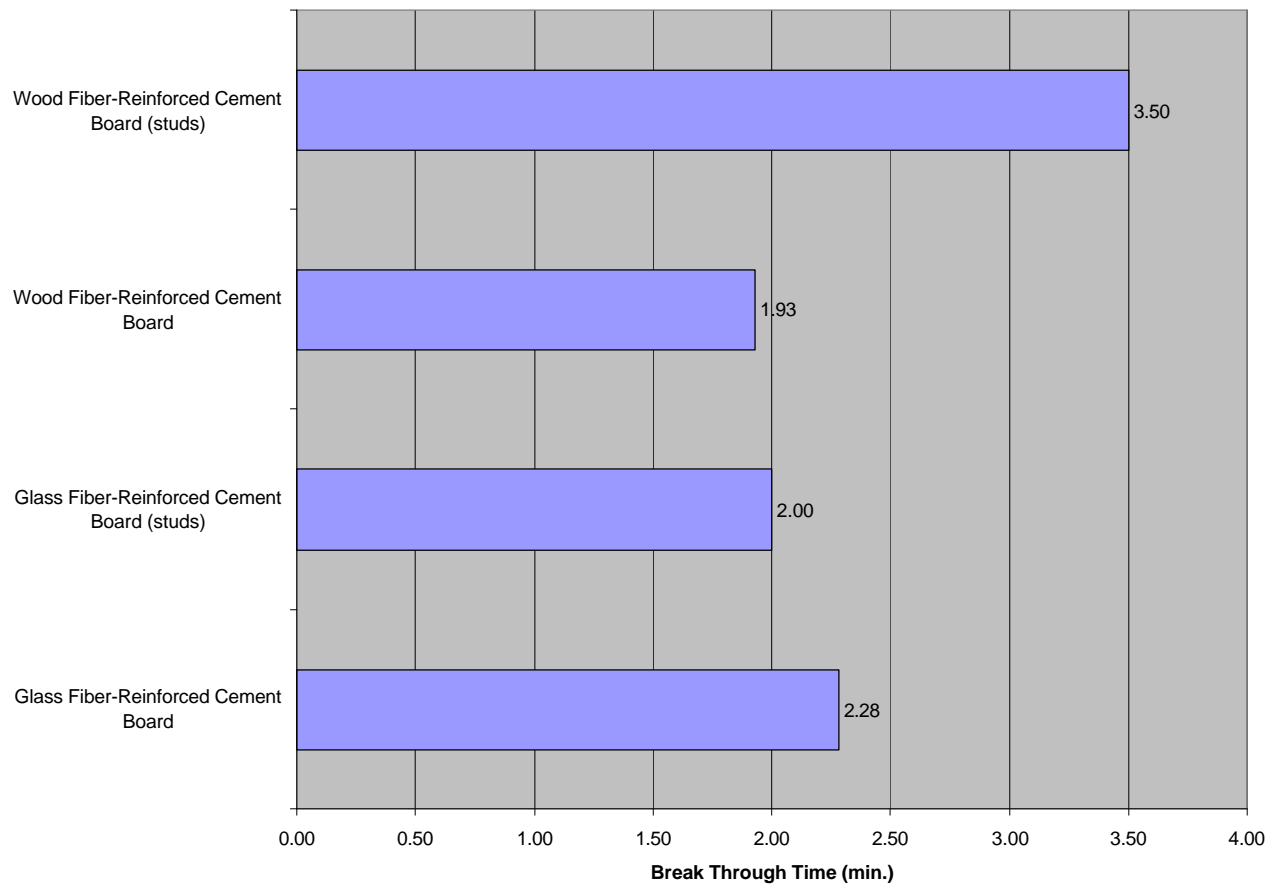
Average Breakthrough Times



US Army Corps
of Engineers

Results (cont.)

Comparison of Breakthrough Times Using Power Tools



US Army Corps
of Engineers

Conclusions

- **The conventional steel stud-cement board walls would all be penetrated in less than 5 minutes.**
 - **Maximum delay time recorded was 4.22 min**
 - **Minimum delay time was 0.10 min (attacker drove an axe completely through the wall in one blow shattering both panels)**
- **Attacking through the studs did not produce a significant increase in the delay time (studs could be bent away)**



Conclusions (cont.)

- Wall with foamed concrete was comparable in delay time to the conventional construction when the attack was in an area without internal pillars
- Wall with closely spaced steel-reinforced internal concrete pillars covered in sheet metal could not be penetrated with any of the tool sets used
 - Total attack time was 12.5 min
 - Only the outer panel and foamed concrete removed



Recommendations

- **Further work should be done evaluating the wall designs incorporating internal pillars**
 - **Additional non-explosive tool kits (cutting torches, etc.) should be used in attack exercises**
 - **Data on cost should be developed for the internal pillar wall**
 - **Costs may be lower than the construction of a continuous reinforced wall or a grouted CMU wall in both original construction and retrofits**

